

**converge**



## SMART METERING & DEMAND RESPONSE WORKSHOP

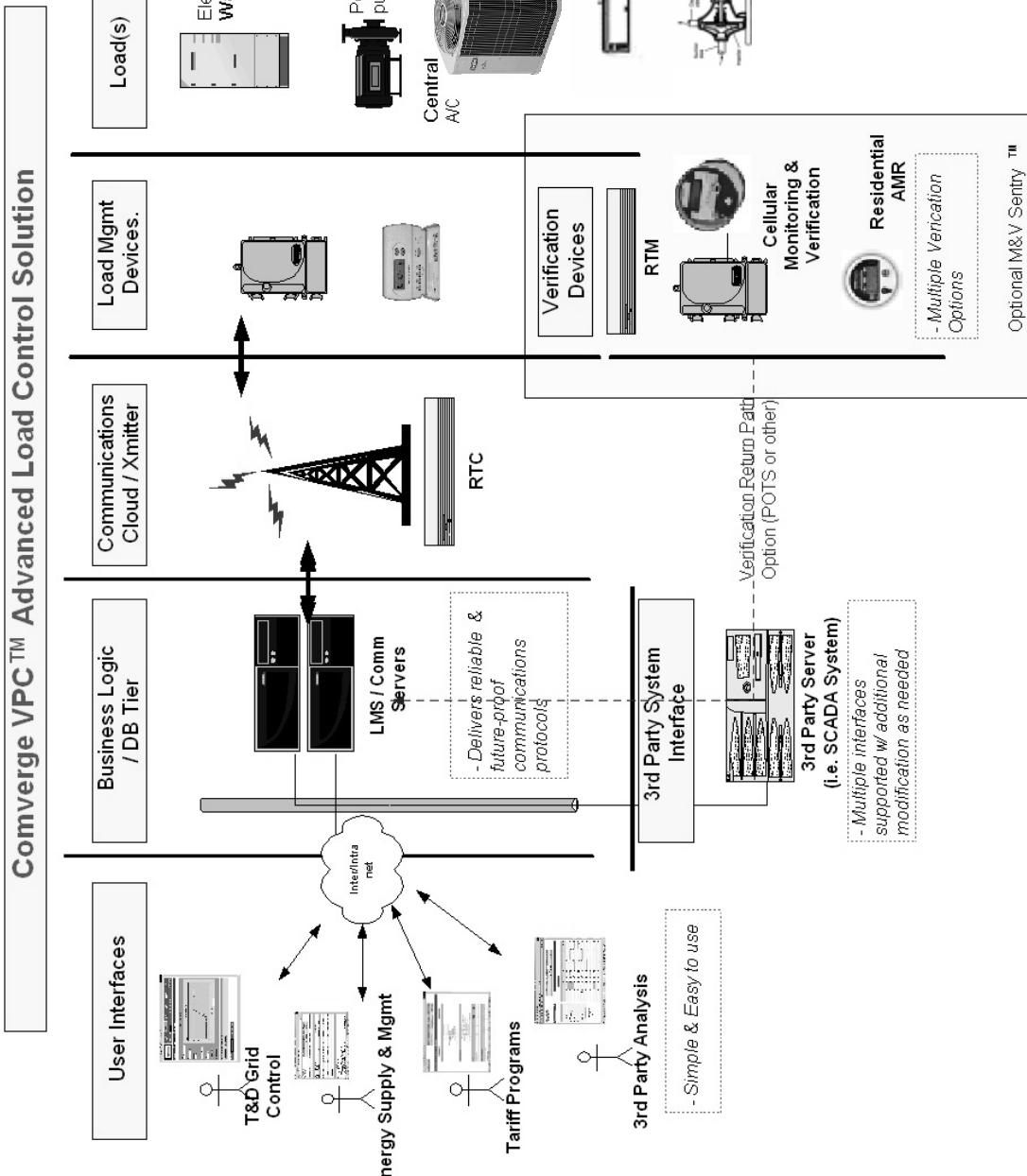
February 22, 2006

## Converge - Who We Are

*We are the leading Demand Response company that provides innovative solutions to significantly reduce an electric utility's peak power costs and enhance grid reliability.*

- Providing software and system solutions to the electric utility industry, Comverge implements both integrated and outsourced solution based models for remote meter reading, distributed generation monitoring, and time-of-use billing and demand response, and direct or voluntary load control initiatives.
- Over 6 million load control units installed
  - 6,000 MW of available load reduction

# Load Control System

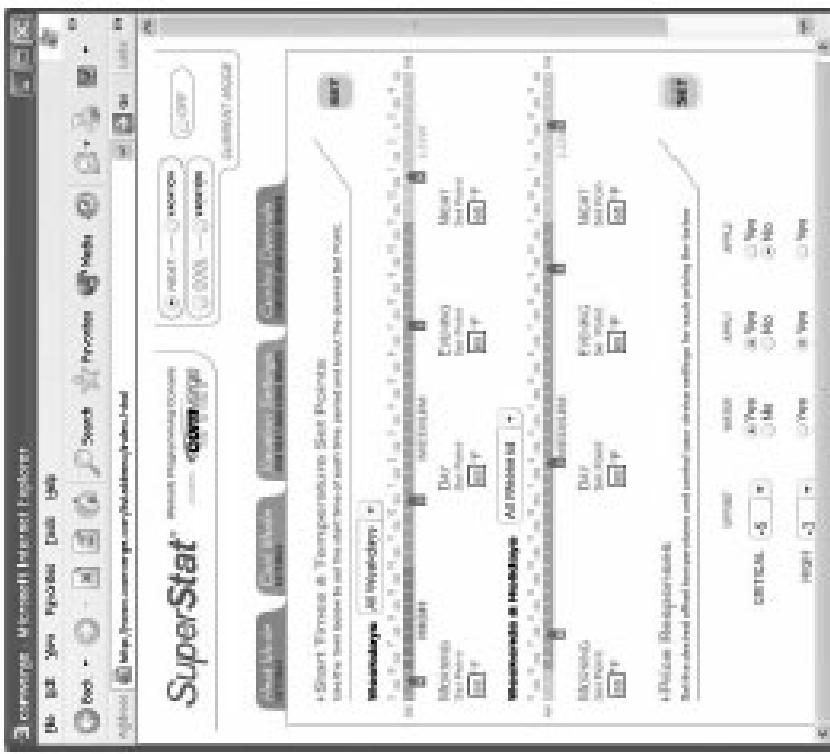


## User Interfaces

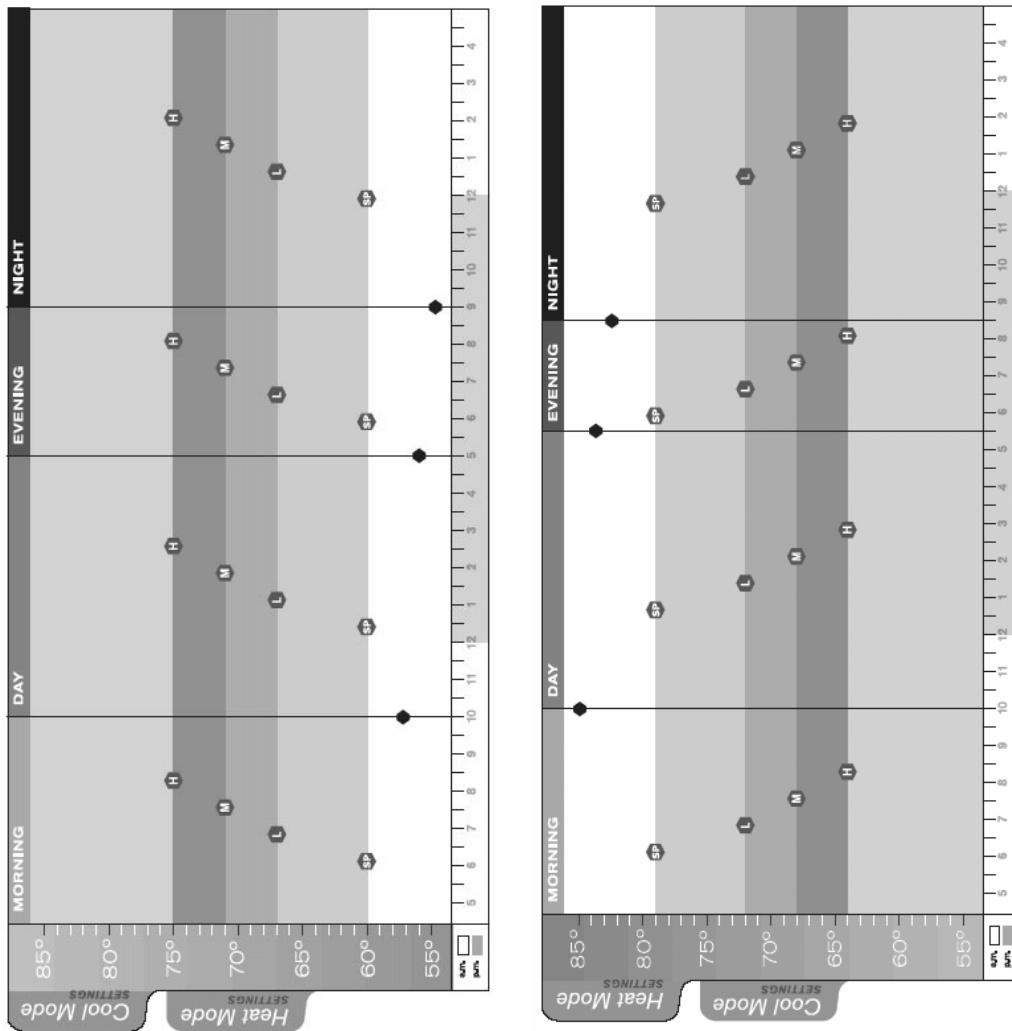
- Personal Computer Based
- Control – Turns Loads Off During Peaks
- Analysis – Analyzes Data for the Utility
- Metering – Collects Meter Readings
- Pricing – Provides Price Information and Control

# Customer Interfaces

## Thermostat settings



## Price Tier Selections



# PowerCAMP Load Management System Overview



- **Configuration** – This module enables the creation of control groups and for the development of different control strategies such that you may give unique treatment to each control group without reprogramming the entire system.
- **Administration** – This module enables the administrator to configure user profiles and system settings.
- **Operate/Control** – This module utilizes the settings to initiate control.
  - There are 3 types of control supported:
    - Manual: Based on user interaction with the system.
    - Scheduled: This control method is based on control configuration parameters such as, time-of-day, day-of-week, or seasonal factors.
    - Triggered: This control is based on the input from external systems that cause triggers for control. Such as, device status, high/low set-points of monitored devices, ISO data, weather information, or any combination of these factors.
- **Monitoring** – This module allows for the visualization of verification and other monitoring/performance values.
- **Analysis/Reports** – This module allows the user to gain access to the operation of the system over time.
- **Customer Interface** – This module enables the customer to program their local thermostat as well and perform other actions allowed by the program.

## Distributed Intelligence Control

- Multiple Cycles with 1 Message
- Combination of Repeating DLC and Linear Control
- RDLC
  - Time-Out
  - Cycle Time
  - Number of Repeats
- Example - 15 minute time-out, 30 minute cycle time, 8 repeats  
= 4 hours of 50% control
- Several combinations available

# *Timeout, Cycle & Function Commands*



**Time-Out** - Period of time, after receipt of a command, that a DCU will stay open before closing again to restore power. Time-outs can be 7.5, 10, 11, 12, 13, 13.5, 14, 15, 16, 16.5, 17, 18, 19, 20, 21, 22.5, 24, 25.5, 27, 28.5, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57 or 60 minutes.

**Cycle Time** - One complete control cycle. Times are 7.5, 15, 20, 30, and 60 minutes. The cycle time is used in conjunction with the time-out to specify the cycle rate of a switch. For example, if a cycle time of 30 minutes and a time out of 15 minutes is specified, the switch will be off for 15 minutes and then on for 15 minutes to complete the 30 minute cycle. The cycle rate is 15 minutes off out of 30 minutes, or 50 percent.

**Cycle Count** - Cycle count is the number of times a DCU will repeat its cycle time. This determines how long control will take place without the receipt of a new command. For example, if the cycle time is 30 minutes and the cycle count is 8, control will continue for 240 minutes. Cycle counts can be specified at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.

**Function Code** - Selects which outputs in the DCU should operate. There can be up to four outputs in a DCU. Each output is capable of controlling a relay driver. In the standard mode, the relay(s) attached to the driver(s) is set so that upon receipt of a message, the relay energizes and removes power from the device being controlled. If no further message command is received, each function will time out and reconnect the controlled load.

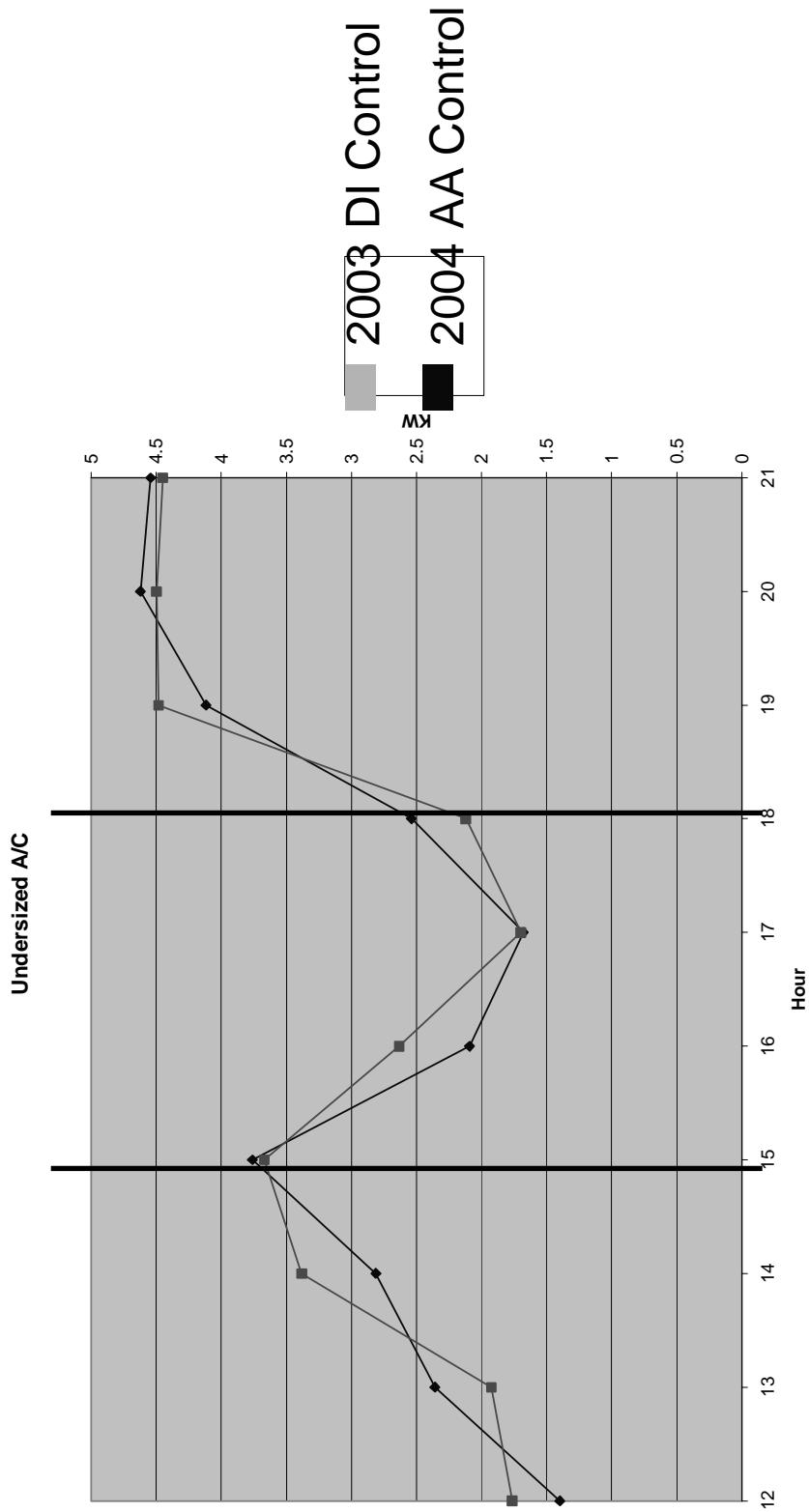
## Adaptive Algorithm Control

- Determine how much each Air Conditioner/Heat Pump runs normally and adjusts control to:
  - Reduce the load equally amongst participants
  - Increase the amount of load reduced
- Eliminate “Free Riders”

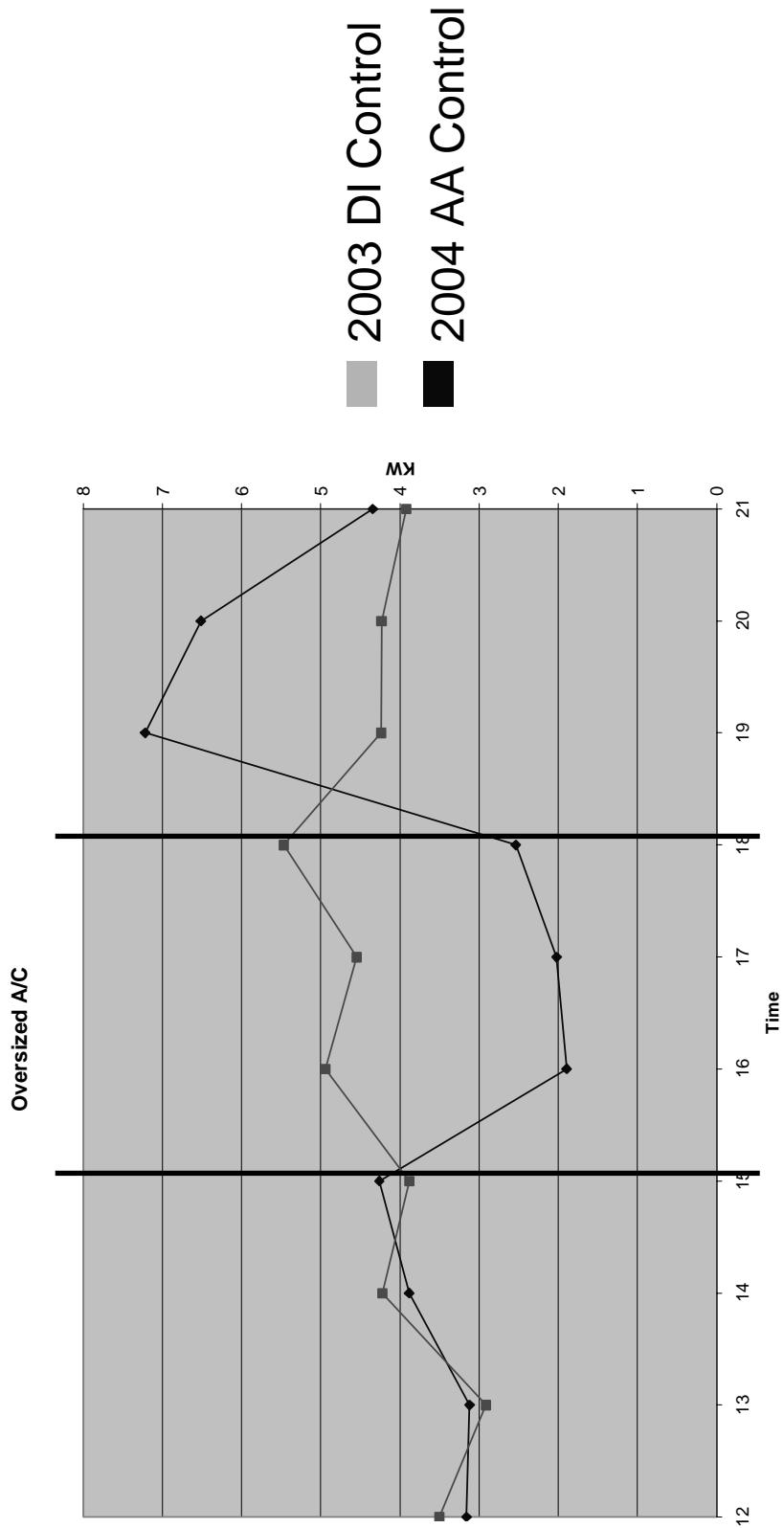
# The Benefits of an Adaptive Algorithm

- Compared to standard algorithms, net result is
  - More cycling equity among customers
  - More predictability in the amount of load shed
- AA cycling at a lower strategy produces
  - Same load shed as conventional systems
  - Less control on high duty cycle accounts
  - More control on low duty cycle accounts
- When cycled at the same strategy
  - More load is shed
  - Amount shed is more predictable
  - More impact (kW) per dollar invested.

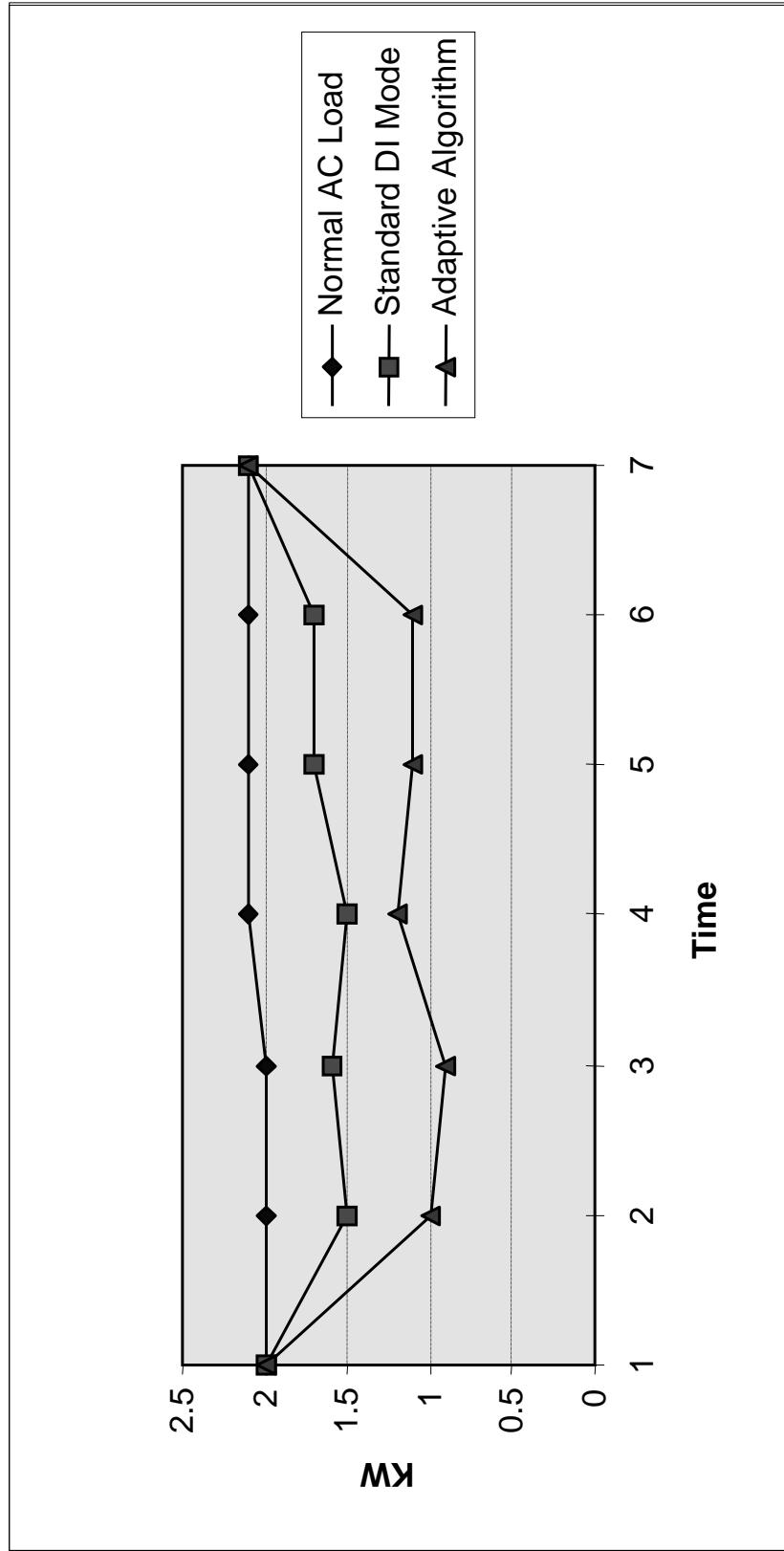
## Effect on Undersized Air Conditioners



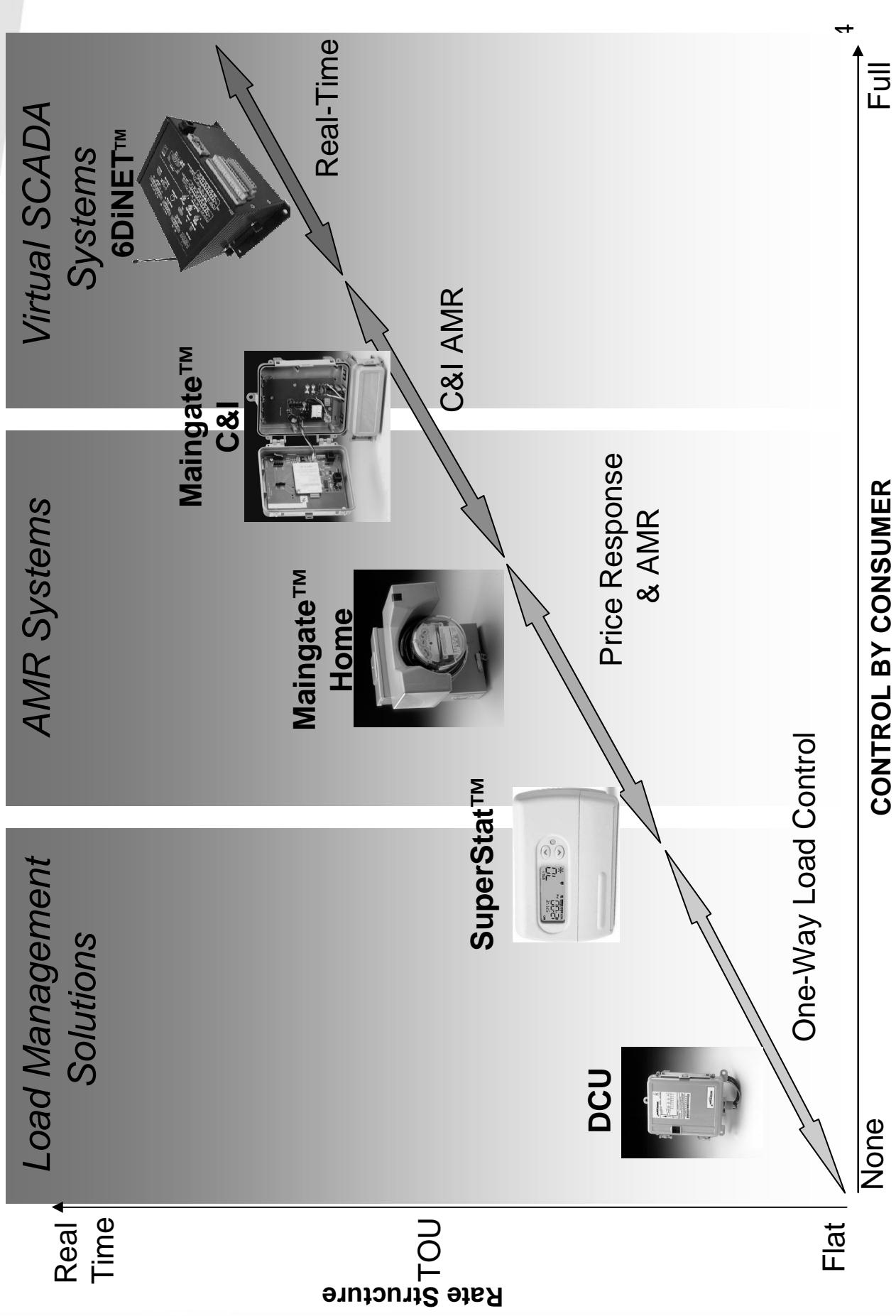
# The Effect on Oversized Air Conditioners



## Adaptive Algorithm Performance

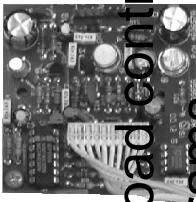
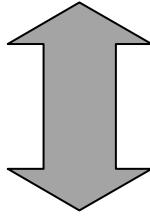
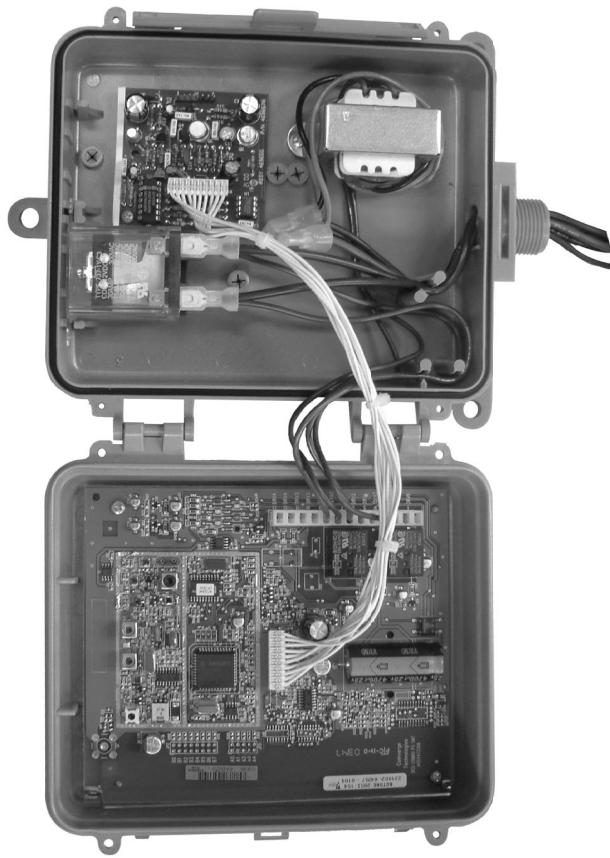


# Solution Spectrum



# Migrateable Technology

Enhanced  
DCU



Enables migration from direct load control to price  
responsive programs

# Measurement & Verification



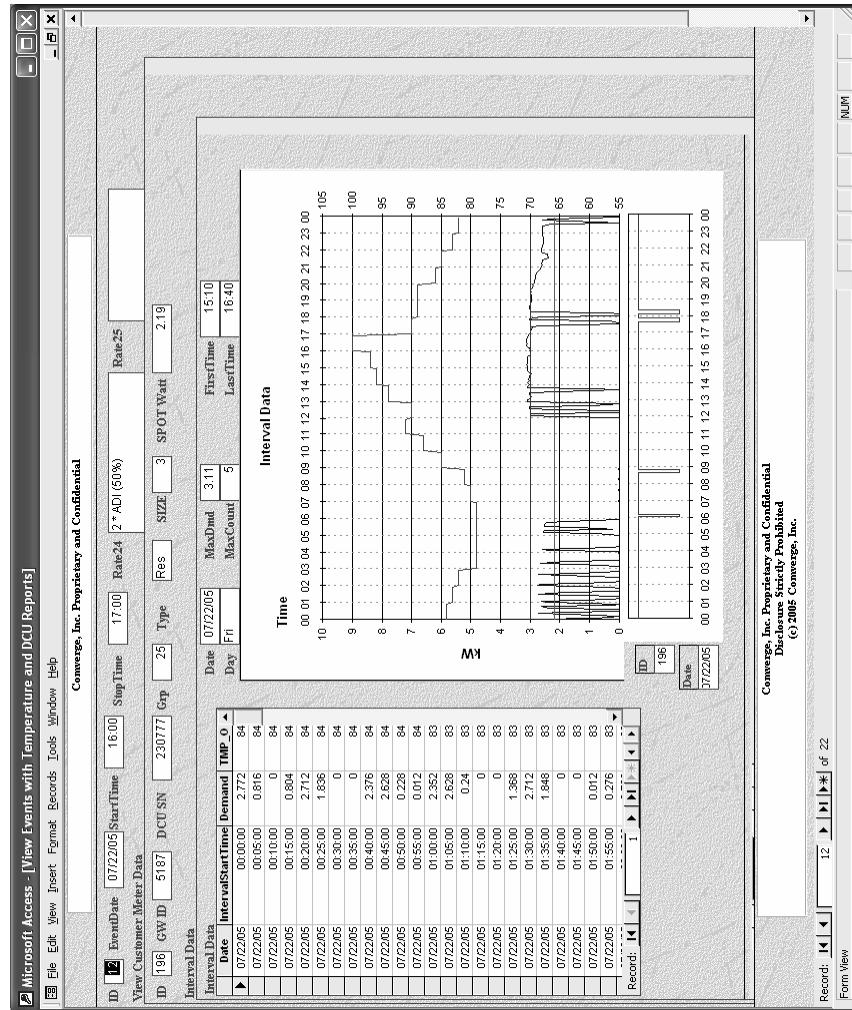
- Sampling rate designed to 90%/10% confidence/accuracy level
- Meters collect data at 5 minute intervals
- Monitoring offers real-time feedback during controls
- Software interfaces with Utility system
- Daily test of equipment availability

# M&V Systems



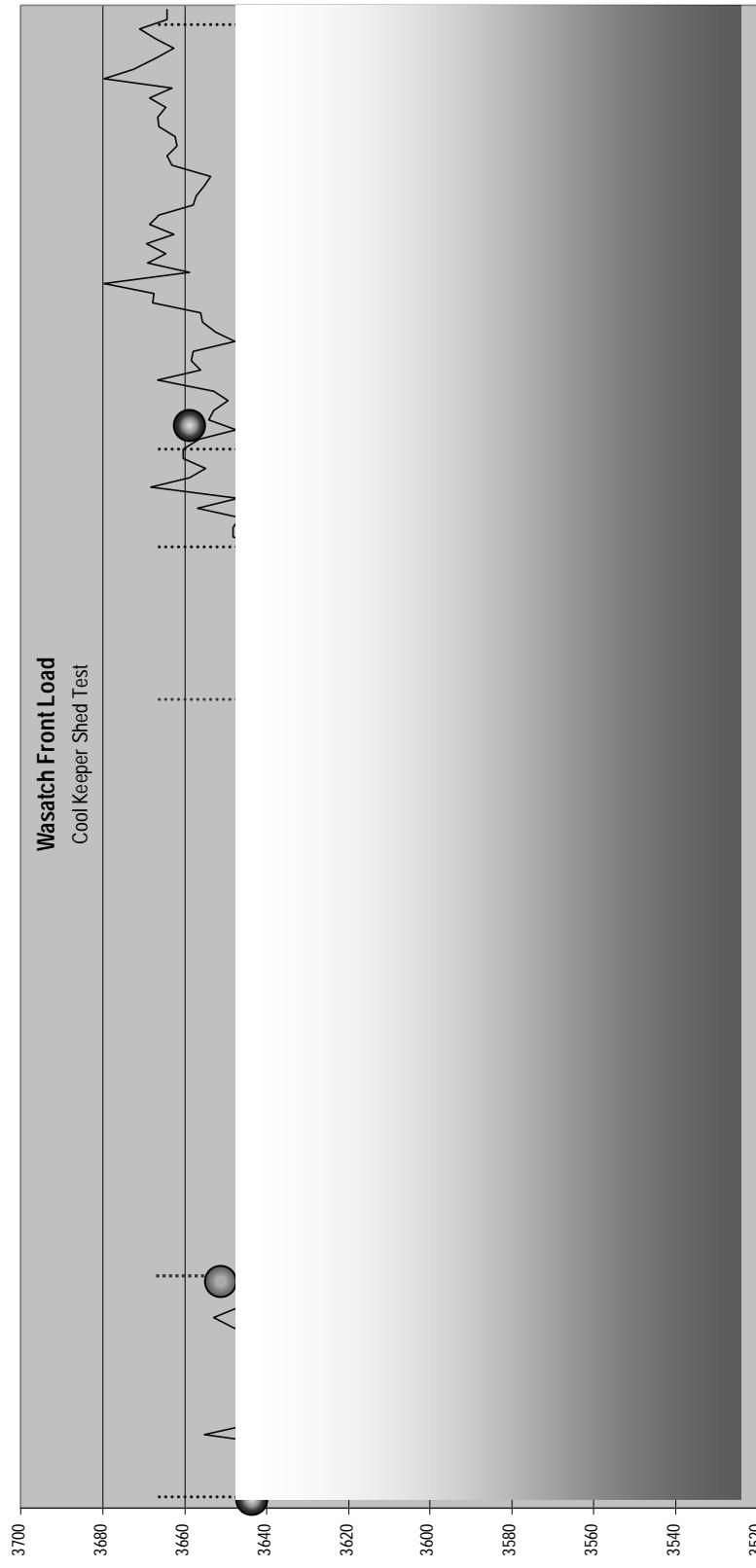
## Landis+Gyr S4 Meter

## CDMA Cellular Gateway



## Digital Control Unit (DCU)

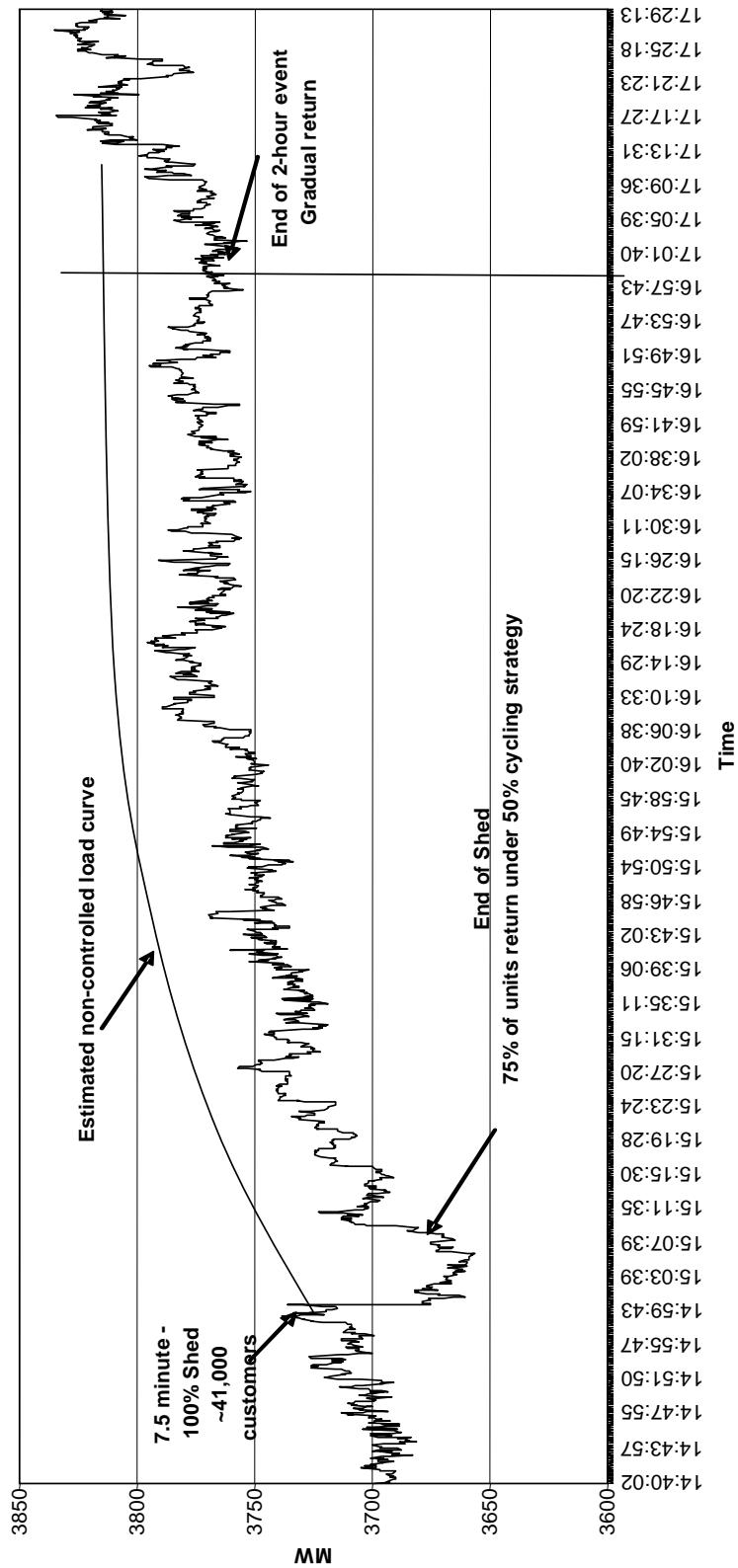
# Proven results with deployed technology



- Control Strategy was 100% shed held for  $\frac{1}{2}$  hour.
- ADI Strategy gives graceful return to normal operations
- Note payback period at end of event
- Event is 14:30 to 15:00 on July 12, 2004
  - Results based on Wasatch front in Salt Lake system load 3,645 to 3,599 at 97 degrees
  - Load represents drop of 1-2% of entire total load

## Proven results with deployed technology (cont.)

July 12, 2005



- Non-Spinning Reserve Classification - Under 1 Minute
- Response~ 60 MW During Shed and 40 MW during Cycling

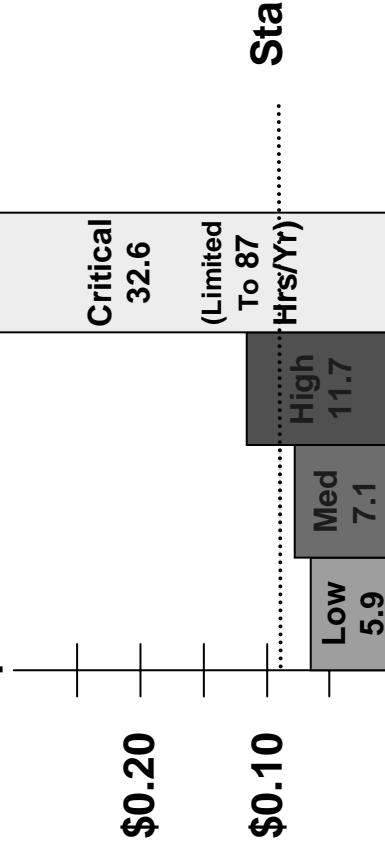
# Gulf Power Critical Peak Pricing

GoodCents Select  
Participation Charge \$4.95/month Standard Residential Rate 8 cents/kWh

Price per kWh*	
Low	5.9 cents
Medium	7.1 cents
High	11.7 cents
Critical	32.6 cents

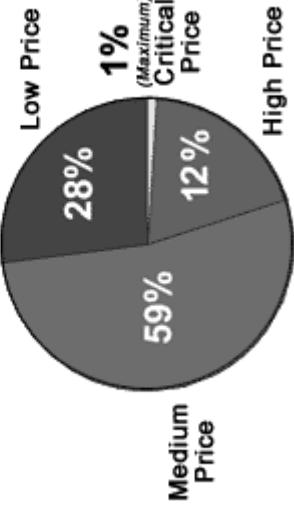
\*All prices are in \$s of DOLLARS, excluding Customer and/or per kilowatt charges and any applicable taxes. These rates are subject to change.

## Price per kWh



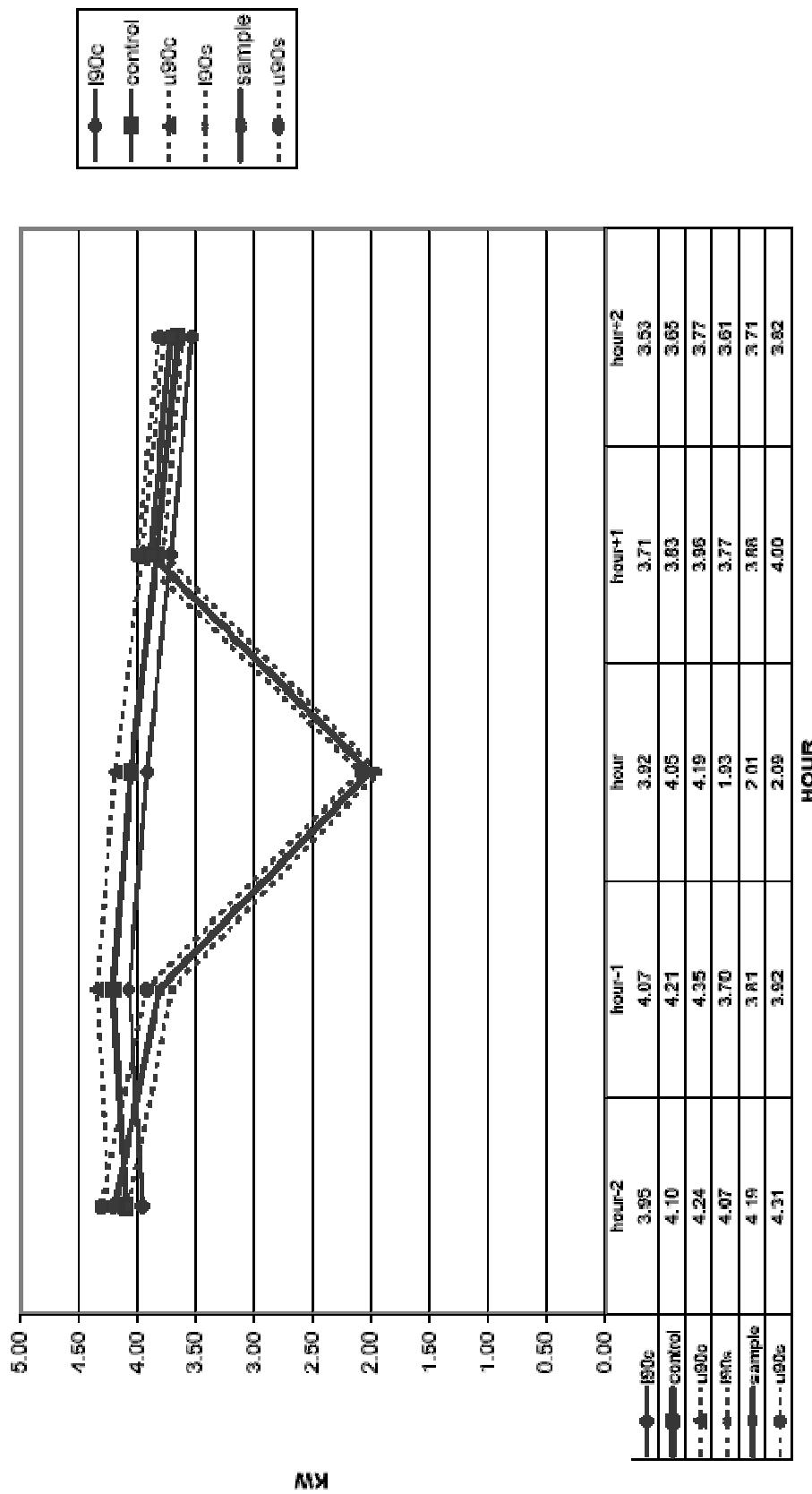
## GoodCents SELECT

Residential Service Variable Pricing (RSVP) Rate  
Percent of Annual Hours In Effect



# Results

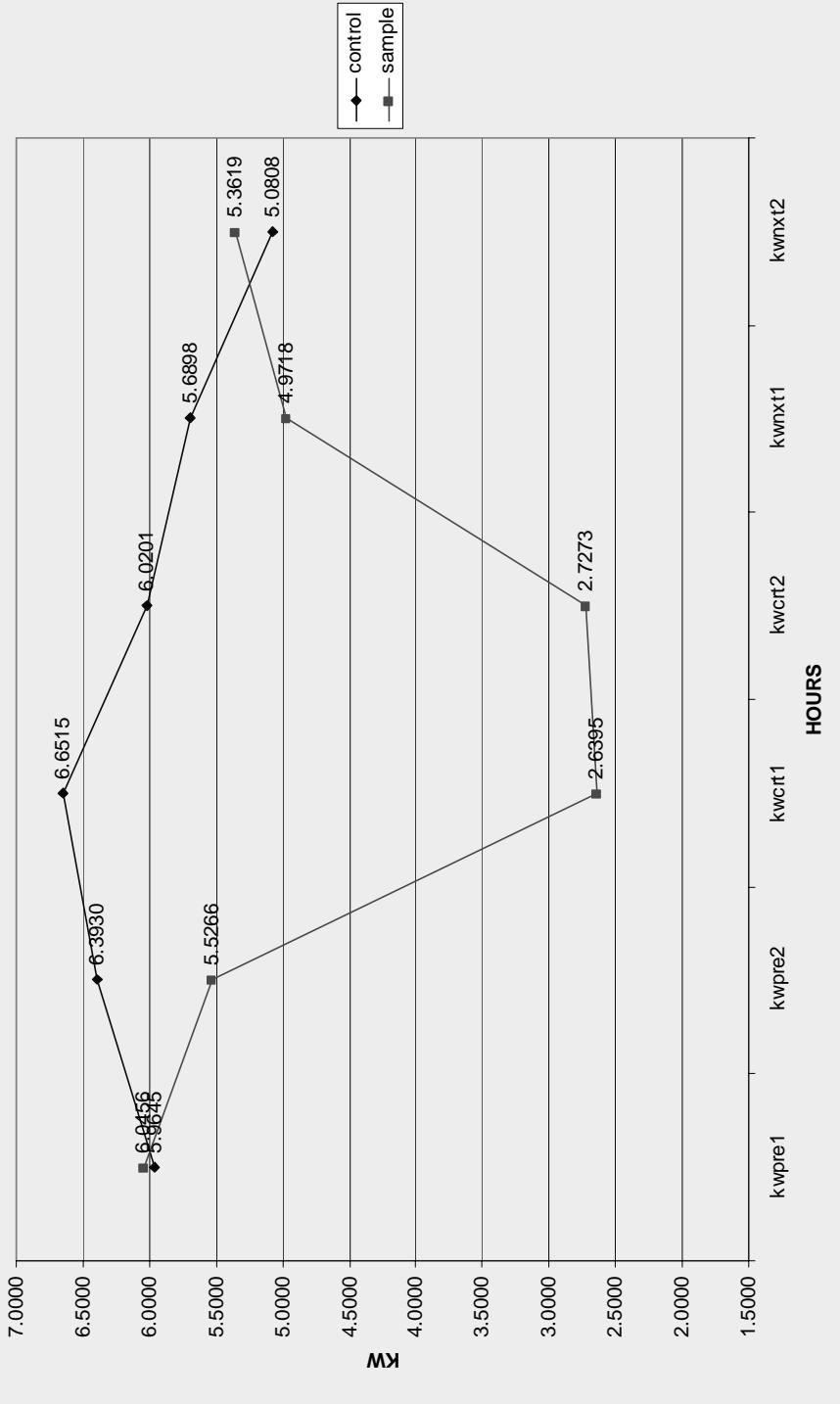
GRAPH 1. PER CUSTOMER AVG KW FOR 2002 (DURATION=1)



Over 2kW Average Reduction

## Results cont'd...

Avg Hourly Demand on Jan 24 at Hour 7 and 8, 2003



4 kW Shift During Critical Winter Peak

# General Comments - A Vendor's Point of View

- Dispatchable direct load control is a highly prized product that offers the ultimate in capacity value and reliability value for the system.
- The Commission's resource adequacy and renewables needs should compel the use of dispatchable direct load control, based on capacity, system reliability and integration benefits.
- Some utilities are ignoring dispatchable direct load control, waiting to use demand / price response for AMI cost-justification - we have the perfect "bridge" solution - financial and technical.
- Converge offers a fully outsourced, long-term solution to remove utility and customer risk, hedge fuel costs, verify savings, target T&D deferral and enable rate-base treatment.
- Risk shifts to Converge, so internal DSM programs, pilots and trials, technology obsolescence, and issues of warranting equipment, installation, and operations are moot - the IOU GETS VERIFIABLE CAPACITY

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